igneous. Intrusive in them are undoubted igneous rocks—gabbro, anorthosite-gabbro, augite-syenite, syenite and dikes of syenite and diabase.

C. K. LEITH.

MADISON, WIS.

THE *Summary Report of the Geological Survey Department of Canada* for the year 1901 is a paper-bound volume of 270 pages, giving a concise outline of the work done during the year. The volume is issued in order to give to the public, without delay, the results of the year's investigations in different parts of the Dominion. The rapidly increasing mining industry of the country makes it very desirable that the information in possession of the Survey should be immediately available, whereas the full annual reports are, as a rule, two or more years behind the field work. During the last three years the Canadian Survey has lost a number of its men by death and resignation. The death of Dr. G. M. Dawson, late director, was a severe loss, and the resignation of such men as J. B. Tyrrel, A. P. Low, J. McEvoy and R. W. Brock leaves places which the younger appointees are not yet able to fill. Dr. Robert Bell, formerly deputy director, has been appointed acting director. The present staff numbers fifty-four.

During the year 1901 thirty-one parties were in the field, and work was done in each of the seven provinces and in the territories of Alberta, Yukon and Keewatin. R. G. McConnel and Joseph Keele continued the work in the Yukon field. Considerable searching has been done in the hope of finding the lodes from which the gold of the placers was derived. Auriferous quartz veins cut the igneous and clastic schists which are so abundant in the Yukon valley. As a rule, the veins, though numerous, are too small and discontinuous to warrant mining operations. The schists are also auriferous in places. R. A. Daly acted as geologist with the Canadian commission co-operating with the United States commission in locating the British Columbia section of the international boundary. The predominant rocks of the Coast Range were found to be metamorphic sediments, of which but few strata were fossiliferous. The mountain forms are regarded as erosional rather than constructional. Erosional features characteristic of the work of Alpine glaciers—cirques, cols, rock basins, ampitheaters, and deep re-entrants—are abundant. The existing glaciers are small, and there is no indication of general glaciation having prevailed in the belt. R. W. Brock worked in the

Boundary Mining District of British Columbia. The rocks of the district are largely eruptives and intrusives, consisting of greenstones, granites, tuffs, and lava, though older sediments, consisting of limestones, argillites, quartzites, and other metamorphic rocks have been caught up and included in the igneous flows. The region is wholly within the area covered by the Cordilleran ice sheet. The striæ show that the movement was mainly S. 30° E. Assorted glacial materials are very abundant, and terracing is very prominent, often reaching a height of 2,000 feet above the present valley levels. The ore bodies are of large size, but irregular in form and usually of low grade. They occur in all rocks except the newest, and mineralization has extended, with gradually decreasing richness, far into the country rock. Deposits within the limestones or the greenstones and at the contact of the two, are of most frequent occurrence. The vein minerals are chiefly magnetite, pyrrhotite, chalcopyrite, marcasite, arsenopyrite, and micaceous hematite, with more or less galena, sphalerite, and molybdenite. Magnetite is never abundant where pyrrhotite is prominent. The values are principally in copper, gold, and silver. The smelters at Grand Forks and Greenwood have been working steadily, but the pyritic smelter at Boundary Falls has not yet been blown in. W. W. Leach continued the examination of the Crow's Nest coal fields, which lie on the eastern border of British Columbia. The main area covers about 230 square miles, has twenty-two distinct seams with a total thickness of 216 feet, of which 100 feet is workable coal of excellent quality. The smaller, or Green Hills area, covers about seven square miles and contains 79 feet of workable coal in seven seams. L. M. Lambe resumed his work on the Cretaceous rocks of the Red Deer River, Alberta, and succeeded "in securing a large collection of chelonian, dinosaurian, crocodilian, fish, primitive mammalian, and other vertebrate remains of considerable value." Two Chelonians — *Trionyx foveatus* and *Trionyx vagans* — are figured and described. William McInnes worked on the pre-Cambrian formations between Lakes Superior and Manitoba. "The primary object of the season's work was to trace with greater accuracy the Sturgeon Lake gold-bearing belt and to work out the geology of an area lying to the southeast of the eastern half of Lac Seul." All of the important Huronian areas of this region are now mapped. Some promising mineral lands are being developed. A. W. G. Wilson spent the summer in the region west of the Nipigon river and lake. The rocks of the area studied belong to the Laurentian, Huronian, and Animikie

series. The Laurentian rocks consist of gneisses and granites with some schists; the Huronian, of ferruginous quartzite interbanded with hematite of good quality and varying in character from soft red to specular. The Animikie formation is the most widespread. A deep red dolomite, varying from a rather heavy bedded, compact, fine-grained rock to a coarser shaly variety, is the most important lithological unit. Associated with the dolomite is a highly ferruginous dolomitic sandstone which locally carries angular masses of quartz. Conformably overlying the red dolomite, on the Upper Spruce river, is a fine-grained, non-fossiliferous, greenish-gray shale, which is capped by fifteen feet of trap. Trappean flows, probably gabbroid, occasionally reaching a thickness of 300 feet, overlie the sediments for the most part, but are in places interbedded with them. In the eastern half of the Nipigon area the Huronian schists pass into jasper and hematite and form three iron ranges, one north and two south of Sturgeon river. Animikie traps are abundant in this area, and show about the same relations to the sedimentary series as in the western half. The explorations of D. B. Dowling in the region to the west of James bay have shown that the Paleozoic area beginning at the southern extremity of James bay extends uninterruptedly along the coast to cape Churchill in Lat. 59° N. The rocks of the newly explored area in the angle between James and Hudson bays are of Silurian age. To the southwest of Cape Henrietta Maria is a considerable area of Animikie rocks consisting of ferruginous slates and jaspers capped by trap.

Work in the vicinity of Lake Abitibi near the Ontario-Quebec boundary resulted in the more accurate mapping of the pre-Cambrian rocks. A. E. Barlow has added many important details to the reconnaissance work done in Denison, Graham and Creighton townships of the Sudbury mining region in 1890. The unaltered rock of the nickel-copper deposits is a quartz-hypersthene-gabbro or norite. The pyrrhotite, chalcopyrite, and pyrite were original constituents of the magma. In the process of slow cooling of these norite masses a species of differentiation resulted in the segregation of the sulphides "so that the final solidification saw the ore-bodies under very much the same conditions as at present obtain." Associated with the norite in the ore-bearing ranges are micropegmatites which are undoubtedly differentiated portions of the nickel-bearing eruptive, as there is a perfect transition from one rock type to the other. There are three distinct bands of the norite and associated micropegmatites. Of these

the southern, having a length of thirty-two miles and an average width of two miles, is the most important, though the others are not without promise. F. D. Adams returned to his work in the pre-Cambrian area of eastern Ontario. Two maps, covering about 4,200 square miles, have been prepared. The northern half of the area is occupied by granite-gneiss (probably equivalent to Logan's fundamental gneiss) while the rocks of the southern area are chiefly ancient sediments, largely limestones, resting on the gneissic series, but invaded, brecciated, and altered by it. Bathylithic masses of gneiss occur in both the granite-gneiss and the ancient sedimentary areas. In the southeastern portion of the area, associated with comparatively unaltered limestones, are masses of amphibolite and other foliated rocks, with an occasional band of conglomerate. The nepheline syenite of the southern portion of the area seems to have some genetic connection with the limestones and with the granites. Intrusions of gabbro are found associated with the amphibolites. In southwestern Ontario, R. Chalmers made a reconnaissance survey of the superficial deposits, and has recorded some observations relative to recent changes of the level of Lakes Huron and Erie. He also gathered data bearing on the salt, oil, and gas industries of that part of the province. In eastern Ontario R. W. Ells has made a re-survey of the Paleozoic formations about Kingston with a view to determining the age of certain limestones and shaly and arkose sandstones forming the basal strata of the sedimentary series. Murray (*Geological Survey of Canada*, 1852–3) regarded the limestones as of Black River age and the sandstones as of Potsdam. The apparent conformity of the two led later workers to suggest that the sandstones were a local development of the Black River. Ells finds abundant proofs of the Black River age of the limestones. As to the sandstones, though no conclusive proofs were found, he inclines to the view of Murray. He gives brief notes on the economic products of the area. Of these the more important are iron, mica, feldspar, marl, and building-stone. The Survey has planned the careful petrographical study of the rocks of the range of volcanic hills which crosses the St. Lawrence valley in the vicinity of Montreal. O. E. Le Roy has completed the work on Rigaud Mountain and is at work on the rocks of Beloeil. Dr. Adams will soon publish a description of Mount Johnson, and he and Professor Harrington are at work on the petrography of Mount Royal. J. A. Dresser finds Shefford Mountain to be composed of essexite, nordmarkite, and pulaskite. Work on Anticosti island confirms the general features of

the report of Richardson in 1856, and the account in the *Geology of Canada*, 1863. Abundant evidence shows that the island is gradually rising. Professor Bailey continued his work on the Paleozoic rocks of southern New Brunswick. Some areas west of St. John river, formerly mapped as Ordovician, on lithological grounds, are found to contain a rather meager Silurian fauna. Similar areas east of the river are probably of the same age. A systematic examination of the Carboniferous strata of New Brunswick, with a view to the discovery of workable coal has not afforded satisfactory results. Some reconnaissance work was done in Prince Edward Island by L. W. Watson. H. Fletcher finds that the sedimentary rocks about the Basin of Mines include representatives of all the Paleozoic groups and the Triassic and the Pleistocene. Igneous rocks are abundant, and include the Triassic traps and the intrusive masses of gray granite and gray diorite. The examination of the outcrops of the Horton series has failed to afford data by which its true position could be determined. It is evident, however, that it is below strata corresponding to the Keokuk-St. Louis. But some would place it near the base of the Devonian. E. R. Fairbault worked on the structural geology of the Cambrian gold-bearing slates and quartzites. The auriferous quartz veins in the area examined follow the contact of the bedded slates and quartzites. In places the folding has caused the development of saddle reefs, but the larger number of veins are on the limbs of the anticlines. G. F. Matthew presents in tabular form the results of his study of the Cambrian rocks of Cape Breton. He shows the completeness of the Cambrian record of the maritime provinces and correlates the formations with those of Great Britain. Extended notes are added on the particulars of the faunas. Dr. Hoffman reports briefly on the chemical and mineralogical work of the Survey. The substantial progress of the mineral industries is shown in the report of E. D. Ingall. A very valuable feature of the report is the index maps of the various provinces showing the areas covered by the various maps published and in preparation, and giving dates of the reports in which the areas are described. J. F. Whiteaves reports on the work in Paleontology.

Some of the individual reports seem to indicate lack of experience both in the prosecution of the field work and in the preparation of the report. The smallness of the parties and the large areas covered by some of them, make it impossible to do more than hasty reconnaissance work.

R. D. GEORGE.